PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04L 12/52, H04Q 11/04 — A2

(11) International Publication Number: WO 00/60815

(43) International Publication Date: 12 October 2000 (12.10.00)

(21) International Application Number: PCT/SE00/00574

(22) International Filing Date: 23 March 2000 (23.03.00)

(30) Priority Data:
9901081-1 23 March 1999 (23.03.99) SE

(71) Applicant (*for all designated States except US*): NET INSIGHT AB [SE/SE]; P.O. Box 42093, S-126 14 Stockholm (SE).

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): BOSTRÖM, Anders [SE/SE]; Mäster Simonsväg 14, S-170 66 Solna (SE). BOHM, Christer [SE/SE]; Skurusundsvägen 40, S-131 46 Nacka (SE).

(74) Agent: AWAPATENT AB; P.O. Box 45086, S-104 30 Stockholm (SE).

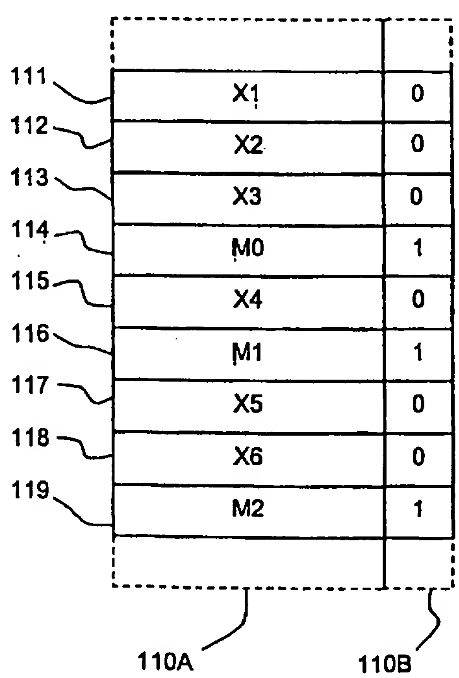
(81) Designated States: AE, AG, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), DM, DZ, EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (Utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
In English translation (filed in Swedish).
Without international search report and to be republished upon receipt of that report.

(54) Title: TRANSFER OF INFORMATION IN A COMMUNICATION NET

(57) Abstract

The present invention relates to a method and a device for transferring information in a communication network, in which control information for controlling the operation and payload of the network is conveyed separately in respective channels which are each defined by one or more time slots allocated in a recurrent frame and each comprising an established number of n bits. According to the invention, each of at least the time slots which define channels conveying payload traffic is associated with a respective additional bit which is used as a flag to indicate whether control information exists as regards the time slot associated with the respective additional bit. The control information in itself, when said additional bit indicates the existence thereof, is conveyed as at least some of the n bits of the time slot associated with said respective additional bit.



TRANSFER OF INFORMATION IN A COMMUNICATION NET

Field of the Invention

The present invention relates to a method and a device for transferring information in a communication network, preferably a DTM network, in which data is conveyed in channels which each comprise one or more time slots allocated in a recurrent frame, preferably DTM time slots of typically 64 bits.

Background Art

DTM (Dynamic Synchronous Transfer Mode) is an example of a communication protocol for broadband transfer. DTM is based on dynamic allocation of resources to circuit-switched channels. The information is transferred in frames of typically 125 μs, each frame being divided into DTM time slots of typically 64 bits. A circuit-switched channel is set up between transmitter and receiver by one or more DTM time slots, or more specifically one or more time slot positions within each frame, being allocated to the channel. If more than one channel is set up, different time slot positions in the frame are allocated to different channels. Thus, a time slot position is never allocated to more than one channel, in any case not over one and the same segment of the network, and different numbers of time slot positions per frame can be allocated to different channels.

When setting up/closing payload channels in a DTM network, use is made of separate control channels for signalling, which also comprise one or more respective DTM time slots in the frame in question. When a payload channel is once established, additional signalling is normally not required before the channel is to be modified or closed, and the control channel may therefore in the meantime be used for signalling regarding other existing payload channels.

For a more detailed description of the DTM protocol and its composition and possibilities, reference is made to "The DTM Gigabit Network" by Christer Bohm, Per Lindgren, Lars Ramfelt and Peter Sjödin, Journal of High Speed Networks 3(2), pp 109-126, 1994, and to "Multi-gigabit Networking Based on DTM" by Lars Gauffin, Lars Håkansson and Björn Pehrson, Computer Networks and ISDN Systems, 24(2), pp 119-139, April 1992.

As mentioned above, a channel in a DTM network is circuit-switched. Moreover, address, priority and/or other control information regarding the operation of the network and the channel in its entirety is transferred normally using the above-mentioned control channels and not in the payload channels. In addition, it is however desirable in certain cases to be able to transfer information which concerns, not the payload channel as such, but the content of specific time slots of a channel. For example, information may be involved, which indicates that data conveyed in a specific time slot is not valid, which may be due to the fact that the transmitter has not transmitted data in the time slot in question (idle slot) or that data in the time slot in question has been made corrupt for some reason or another (error slot). Information may also be involved, which indicates that the slot in question constitutes the start of a packet or the end of a packet which is conveyed in the channel in question. This type of control information which does not concern the operation of the network as such or the channel in its entirety but rather the status of or the content of specific individual time slots will below be referred to as control information or metainformation.

One way of conveying metainformation which relates to one or more specific time slots of a channel is to transmit this in the above-mentioned control channels. An advantage of this solution is that control time slots as such and mechanisms for how they are handled are avail-

able in all DTM networks. However, this solution means an increase of the amount of signalling in the control channels, which, to the extent that capacity is missing, may result in, for example, longer setting-up times. Moreover control channels are required along each payload channel or intelligence must be available to switch the correct metainformation to follow the correct channel. Nor is it a simple operation to synchronise the transfer of data in a time slot with the transfer of metainformation associated with the time slot in control channels.

A more advantageous method of conveying the metainformation therefore is to transmit the same in connection with the actual DTM time slot to which the information relates.

The use of this type of metainformation is known, for example from US Patent No. 5,027,349 which discloses a method by which control information is provided with a kind of metainformation. This prior-art technique, however, only shows how metainformation is supplied in respect of status of transferred control information and does not concern at all how metainformation is to be processed in relation to payload traffic on circuit-switched channels.

A more closely related example is given in Christer Bohm, "Circuit Switching for High Performance Integrated Service Networks", Royal Institute of Technology, Stockholm, ISSN 1103-534X, June 1996, pp 69-71, which describes a method of identifying the intervals between packets that are conveyed asynchronously via a circuit-switched DTM channel. A problem of the solution described, however, is that on the one hand it involves restrictions as to how many different types of metainformation are allowed and, on the other hand, it places demands on the sequence in which different types of metainformation are allowed to succeed within a channel.

An object of the invention thus is to provide a solution to the above problems of prior-art technique.

Description of the Invention

The above and also other objects are achieved by the invention as defined in the appended claims.

According to one aspect of the invention, metainformation of the above type is conveyed by associating to each time slot of n bits, preferably a DTM time slot of 64 bits, a respective additional bit which in itself does not constitute part of a DTM time slot. This additional bit is used as a flag which indicates the presence of metainformation. According to the invention the flag is thus used to mark that the time slot associated with the flag does not convey payload transmitted by the transmitter, but instead conveys metainformation. The actual metainformation is collected/read, in the case of the flag being set, from the n bits of the time slot itself, which makes it possible to transmit several different types of metainformation.

An advantage of the invention is that several types of metainformation can be carried in the actual DTM time slot and be indicated by a single flag of one (1) bit. For instance, the metainformation carried in the DTM time slot when the flag is set can identify that the DTM time slot a) does not convey payload, b) replaces incorrect payload or partly conveys payload that has been made corrupt, c) marks the start of a data packet conveyed in the channel, or d) marks the end of a data packet.

Certainly a drawback of this solution is that systems operating according to this principle must be designed to process an additional bit for each time slot of 64 bits, i.e. a total of 65 bits. Since buses, memories, connecting means etc are often available in standard design for 64 bits, the inclusion of a 65th bit in such cases may cause difficulties in terms of construction. An obvious advantage of this solution, however, is that in an otherwise very simple manner it enables signalling and conveyance of several different types of metainformation using a minimum overhead.

The fact that a single bit and not significantly more is used for this purpose has the advantage that the standard design involving 64 bits is changed as little as possible. However, this solution could also be accomplished by using a flag which comprises more than one bit.

The solution of using a 65th bit is also particularly advantageous when DTM time slots and associated metainformation are to be transferred between ports of a switch in a communication network since the above-mentioned flag can easily be conveyed/switched together with the associated DTM time slot (which optionally carries metainformation) transparently through the switch without demanding much interpreting logics or processing of information.

An alternative way of conveying metainformation of the above type is to use so-called 8B/10B coding, which is then used to code the 64 bits of each DTM time slot to 80 bits, in which case certain predetermined such words of 80 bits are selected to designate a certain type of metainformation instead of payload.

An advantage of this solution is that the overhead which the coding in itself involves and which is accepted to create a functioning bit coding on the conveying medium is also taken care of as a conveying medium for the metainformation, in which case the transfer of metainformation associated with a DTM time slot in a natural fashion is always fully synchronised with and follows the transfer of the actual DTM time slot. It goes without saying that a disadvantage of this solution is the bandwidth that is wasted owing to the coding.

In those cases, one or more of the ports of a switch can be arranged to convert the above-mentioned flag, where appropriate, and the metainformation intended with the flag, into an output conveying format, in which metainformation, if any, is incorporated in the manner applicable to the conveying medium and the port respectively.

This can occur, for instance, by a set flag and associated metainformation being converted into a specific bit pattern using coding as discussed above, alternatively by a port fully supplying the flag and the associated 64-bit time slot as 65 bits between the switch core and the link to which the port is connected.

According to a preferred embodiment, a 65th bit is used according to the invention to transfer DTM time slots and associated metainformation, if any, using a different communication control as the underlying carrier, for example when DTM is to be conveyed over SDH (Synchronous Digital Hierarchy), or the US counterpart SONET. For each DTM time slot of typically 64 bits, one simply seizes 65 bits of the payload conveying capacity of the underlying protocol, the 65th bit being used as described above. When DTM is to be conveyed over, for example, SDH/SONET, each DTM time slot of 64 bits and the above-mentioned bit associated therewith are mapped in order to jointly hold 65 bits in a virtual container (VC) in SDH/SONET, such as a VC-4 or VC-3 container. In such a situation it is, of course, preferred that it be determined in advance how each VC-4 is divided into words of 64+1 bits, which means that the DTM time slots and associated bits take predetermined positions in each virtual container.

According to an alternative embodiment, it would, for example, be possible to use one more bit per time slot as parity bit. In that case, a DTM time slot of 64 bits would be transmitted as 66 bits in the form of a metainformation flag of one (1) bit, the actual 64-bit DTM slot (which, where appropriate (as indicated by the flag), can convey metainformation), and a parity bit.

It is preferred for each flag of the above-mentioned type to be conveyed in direct connection with the associated DTM time slot. Alternatively, it is possible to choose, for example, to collect the flags for a limited number of DTM time slots and then convey these flags

in a joint group. This can be accomplished, for example, in such manner that each group of eight DTM time slots of 64 bits is each preceded or followed by a group of eight associated flags of one bit each.

Brief Description of the Drawings

Exemplifying embodiments of the invention will now be described with reference to the accompanying drawings, in which

Fig. 1 shows a switch which operates according to embodiments of the invention;

Figs 2a and 2b show a STM-1 conveying module which conveys DTM time slots according to an embodiment of the invention; and

Fig. 3 shows a sequence of DTM time slots and associated metainformation according to an embodiment of the invention.

Detailed Description of Preferred Embodiments

Fig. 1 illustrates a switch 10 comprising two ports 11 and 12 which receive bit streams 1 and 2, and two ports 13 and 14 which transmit bit streams 3 and 4. Moreover, the switch comprises a switch core 15 which switches data between the four ports.

Each of the bit streams 1, 2 and 3 is divided into frames of 125 μs which in turn are each divided into time slots of 64 bits according to the DTM protocol. As schematically illustrated in connection with the bit stream 2, each DTM time slot 21 of 64 bits encoded to words 22 of 80 bits is transmitted. In the exemplified case, the encoding is carried out in such manner that each octet (8 bits) 21A of each DTM time slot 21 is encoded to form a bit group 22A of 10 bits in accordance with so-called 8B/10B coding. In those cases where a DTM time slot is to be provided with metainformation, for example when it is to be marked that a DTM time slot has data errors because the payload conveyed in the slot had been made corrupt,

code words representing the selected metainformation is selected in this encoding. The metainformation associated with a time slot thus is embedded in the actual coding of the DTM time slot in question. As schematically illustrated in Fig. 2, also the bit streams 1 and 3 convey data in coded DTM time slots in the same way as described starting from bit stream 2.

For each DTM time slot received by the port 12, i.e. for each code word of 80 bits, the port 12 is adapted to decode the code word in question to regenerate the actual DTM time slot of 64 bits. In the exemplifying switch 10, the port 12 also performs a paralleling of the 64 bits of the DTM time slot. From the port 12, each DTM time slot of 64 bits is thus transmitted in the form of 64 parallel bits on 64 respective lines 27 which are connected to the switch core 15. If, in connection with decoding which is carried out by the port 12, it is established that metainformation is present for a certain time slot, this is marked by a flag in the form of an additional bit being activated ("1-set"), which bit is transmitted simultaneously with the paralleled DTM time slot on an additional line 26, parallel with the lines 27, to the switch core 15. Since the existence of such metainformation means that data in the actual DTM time slot does not constitute the correct payload, the 64 bits of the DTM time slot are in this case used to mark what type of metainformation is intended. In other words, the flag in the form of the 65th bit (line 26) is used to mark that there is metainformation to be read in the associated DTM time slot. Instead of payload, the actual time slot, when indicated by the flag, is provided with information marking one of more alternatives of metainformation, for example that the transmitter has not transmitted data in the time slot in question (idle slot), that data in the time slot in question has been made corrupt for some reason or another (error slot), that the slot in question constitutes the start of a packet, or that it constitutes

the end of a packet, as will be exemplified further with reference to Fig. 3.

As schematically illustrated in Fig. 1, time slots and flags are transferred in this manner also between the remaining ports 11, 13, 14 and the switch core 15. The switch core 15 is in turn adapted to switch time slots of 65 bits, i.e. a 64-bit DTM time slot plus the associated 65th bit, between the different ports according to the switching instructions that are established when setting up channels. This switching procedure thus is essentially the same as the one carried out when switching conventional DTM time slots of 64 bits, except that an additional bit now accompanies each DTM time slot through the switch core 15.

The port 13 is adapted to perform a function similar to the port 12, although in the reverse direction. The port 13 thus is adapted to transmit DTM time slots of 64 bits, which are obtained from the switch core 15, encoded to words of 80 bits, as described above. Each time the port 13 receives from the switch core 15 a DTM time slot for which the associated flag is set (activated), indicating the presence of metainformation, the port will instead of payload transmit an 80-bit word which is specifically selected on the basis of the metainformation to which the flag in question is related.

In Fig. 1, the port 14 differs from the remaining ports in that this port is adapted to transmit DTM time slots over an underlying protocol. In the schematically illustrated case, the port is adapted to transfer DTM over SDH. The bit stream 4 thus conveys data, using SDH, and in this case it is specifically assumed that this occurs while using the protocol for STM-1, an STM-1 conveying module 29 of 125 μs being schematically shown in Fig. 1.

Figs 2a and 2b schematically illustrate the composition of an STM-1 conveying module of the type indicated in Fig. 1 and conveying DTM time slots according to an

embodiment of the invention. Fig. 2a shows how an STM-1 conveying module in a conventional fashion can be regarded as a matrix of octets distributed in 270 columns of 9 rows each. An entire STM-1 conveying module thus contains 270x9x8=19440 bits. The first 9 columns of the module form a field which is referred to as Section Overhead, SOH, which conveys control information. The remaining 261 columns form a payload field in the form of a virtual container VC, which in the case shown is a virtual container of the type VC-4. It is to be noted that the position of each such container need not be fixedly connected to the position of the STM-1 conveying module, but the position (start) of the container in the payload field can be indicated by a pointer field 31 in said Section Overhead.

The first column of the virtual container forms a field which is referred to as Path Overhead, POH, and which contains additional signalling information. The remaining 260 columns of the virtual container form in the exemplifying case nine containers 35 of the type C-4, one per row. Each such C-4 container thus contains 260x8=2080 bits, which exactly corresponds to 32 DTM time slots, which according to the invention are supplemented with associated respective flags (32x(64+1)=2080). According to this embodiment, 32 DTM time slots and associated flags can thus be mapped into each C-4 container. One example of this is illustrated in Fig. 2b, which schematically shows the start of a C-4 container 35, in which DTM time slots 40A, 41A, 42A, each comprising 64 bits, are placed in serial sequence, separated by 1-bit flags 40B, 41B, 42B belonging to the respective DTM time slots. In the exemplifying case, the port 14 in Fig. 1 is thus adapted to transmit DTM time slots of 64 bits, in the form as received from the switch core 15 in C-4 containers of STM-1 together with the extra bit which constitutes the above-mentioned flag in the manner schematically shown in Fig. 2a. This means that if the port 14

receives a flag which is 1-set and which thus indicates that the associated DTM time slot contains metainformation, the port will simply transfer this indication to the STM-1 module, so that, for example, the flag 40B indicates that there is metainformation to be read in the DTM time slot 40A. If the port 14 in a similar manner receives a flag which is 0-set, indicating that data conveyed in the associated received DTM time slot is payload for which no metainformation exists, the port transmits this 0-set flag together with the associated, payload-carrying DTM time slot, for example as flag 41B and time slot 41A.

As an alternative to that described with reference to Fig. 2b, the mapping over SDH according to the invention could, for example, also comprise, for each DTM time slot, a parity bit which is then used to check the correct mapping. For instance, the rule of the parity bit would be that the sum of the number of ones in the 64-bit time slot and the parity bit would always form an even number. Since this solution de facto seizes 66 bits per DTM time slot (a metainformation flag, the actual 64-bit DTM time slot, and a parity bit) and not only 65, a somewhat smaller number of slots can be conveyed in each virtual container than in the case where no parity bit is used.

Fig. 3 shows a sequence of DTM time slots and associated metainformation according to an embodiment of the invention. For example, the sequence of DTM time slots as shown in Fig. 3 may be the sequence of DTM time slots transmitted from the port 12 to the switch core 15 in Fig. 1, in which case the field designated 110A in Fig. 3 schematically shows a sequence of 64-bit DTM time slots which are transmitted on the lines 27 in Fig. 1, while the field designated 110B in Fig. 3 schematically shows a sequence of 1-bit flags associated with the respective DTM time slots and transmitted on the line 26 in Fig. 1.

As schematically shown in Fig. 3, the flags which are associated with the DTM time slots 111, 112, 113, 115, 117 and 118 are zeroised, which in the exemplifying case indicates that data X1, X2, X3, X4, X5 and X6, respectively, which is conveyed in these DTM time slots constitutes payload which has been transmitted by the transmitter. It is also apparent that the flags which are associated with the DTM time slots 114, 116 and 119 are 1-set, which indicates that data M0, M1 and M2, respectively which is transmitted in these DTM time slots constitutes metainformation. More specifically, metainformation M0 in the DTM time slot 114 intends to mark that the transmitter has not transmitted payload in the time slot in question (idle slot). The metainformation M1 in the DTM time slot 116 is in this example assumed to mark that payload which has been conveyed in this time slot has been made corrupt (error data). Finally the metainformation M2 in the DTM time slot 119 in this example is assumed to mark that this time slot constitutes the end of a packet which is conveyed in the channel to which the time slot 119 belongs.

Although the invention has been described above with reference to specific embodiments, it will be appreciated that a large number of variants, combinations, modifications and changes can be carried out within the scope of the invention, which is defined by the appended claims. For example, the invention can be used to transfer DTM over other protocols than SDH, and instead of using a bus to transfer DTM time slots and associated flags through a switch as described above, a large number of other techniques can be used to transfer the information in question in time- and/or space-multiplexed form.

CLAIMS

1. A method for transferring information in a time-multiplexed communication network, in which control information for controlling the operation and payload traffic of the network is conveyed in separate channels which are each defined by one or more time slots allocated in a recurrent frame, each of said time slots comprising an established number of n bits, said method comprising the steps of:

associating each of at least those time slots (110A) which define channels conveying payload traffic with a respective additional bit (110B) which is used as a flag for indicating whether control information exists regarding the time slot associated with the respective additional bit; and

conveying said control information, when said additional bit indicates the existence thereof, as at least some of the n bits of the time slot associated with said additional bit.

2. A method as claimed in claim 1, comprising the step of associating also the time slots which define channels conveying control information with a respective additional bit which is used as a flag for indicating whether control information exists regarding the time slot associated with the respective additional bit, said control information being conveyed as at least some of the n bits of the time slot associated with said respective additional bit.

3. A method as claimed in claim 1 or 2, wherein said control information can be of different types and wherein only the existence of control information and not the type of control information is indicated by the bit which

is associated with the time slot in which said control information is conveyed.

4. A method as claimed in claim 1, 2 or 3, wherein said control information (M0) identifies that the time slot in which the control information is conveyed does not convey payload.

5. A method as claimed in claim 1, 2 or 3, wherein said control information (M1) identifies that the time slot in which the control information is conveyed replaces erroneous payload.

6. A method as claimed in claim 1, 2 or 3, wherein said control information identifies that the time slot in which the control information is conveyed marks the start of a packet.

7. A method as claimed in claim 1, 2 or 3, wherein said control information (M2) identifies that the time slot in which the control information is conveyed marks the end of a packet.

8. A method as claimed in any one of the preceding claims, which is used in respect of DTM time slots in a DTM network.

9. A method as claimed in any one of the preceding claims, which is used when conveying DTM time slots, each with its respective additional associated bit, over an underlying communication protocol.

10. A method as claimed in claim 9, which is used when conveying DTM time slots, each with its respective additional associated bit, over SDH/SONET.

11. A method as claimed in claim 10, wherein each individual DTM time slot of 64 bits to be conveyed over SDH/SONET is mapped together with said bit associated therewith to jointly hold 65 bits in a virtual container (VC) in SDH/ SONET.

12. A method as claimed in claim 11, wherein each individual DTM time slot of 64 bits to be conveyed over SDH/SONET is mapped together with said data bit associated therewith and an additional parity bit to jointly hold 66 bits in a virtual container (VC) in SDH/ SONET.

13. A device (10) for transferring information in a communication network, in which control information for controlling the operation and payload traffic of the network is conveyed separately in respective circuit-switched channels which each comprise one or more time slots which are allocated in a recurrent frame and which each comprise an established number of n bits, said device comprising means (11, 12, 13, 14) which, for each of at least those time slots (110A) which define channels conveying payload traffic, and preferably all time slots, associate a respective additional bit (110B) which is used as a flag for indicating whether control information exists with regard to the time slot associated with the respective additional bit; and which are adapted to read/write said control information, when said additional bit indicates/ is set to indicate the existence thereof, from/to at least some of the n bits of the time slot associated with said respective additional bit.

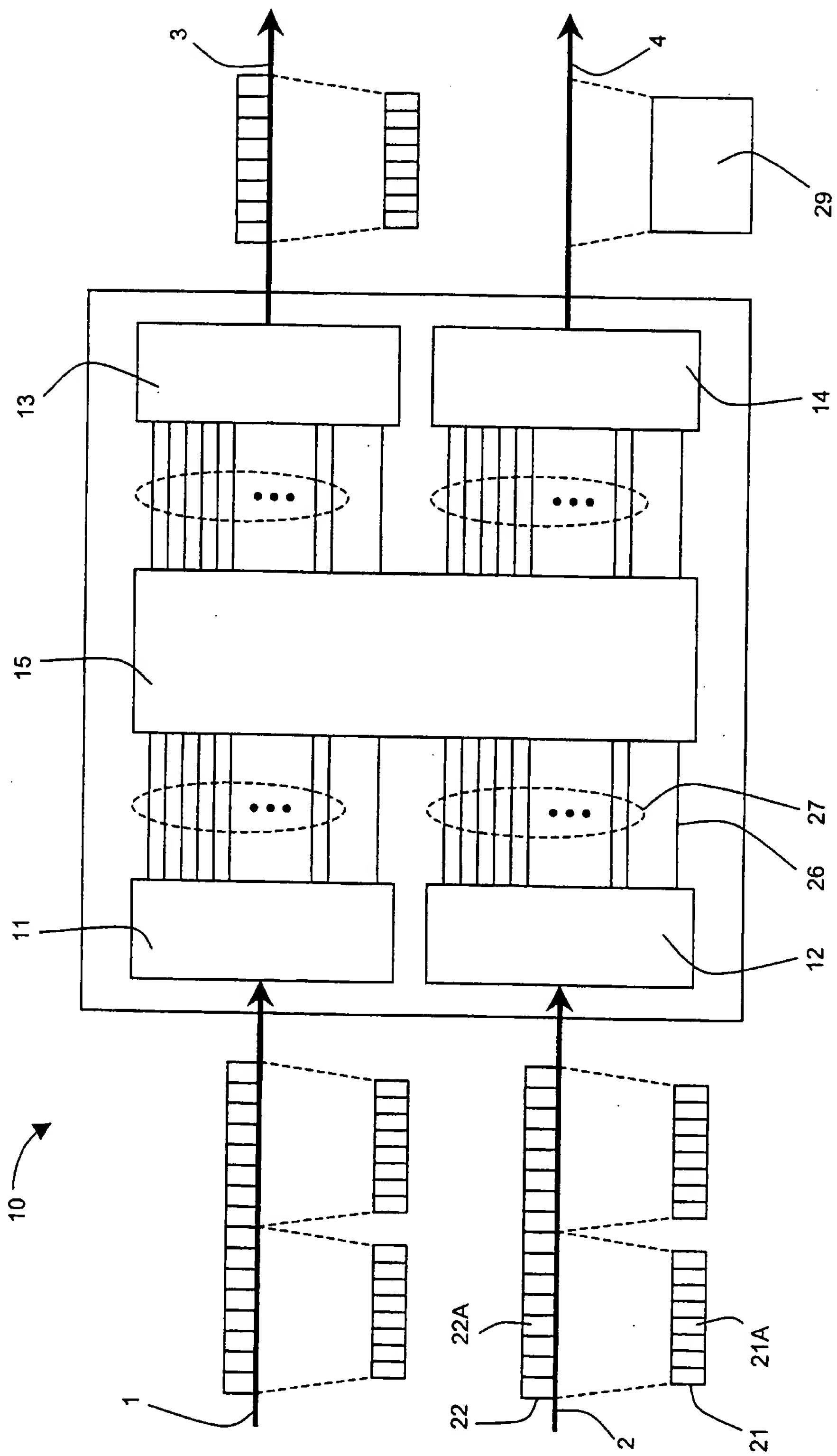


FIG. 1

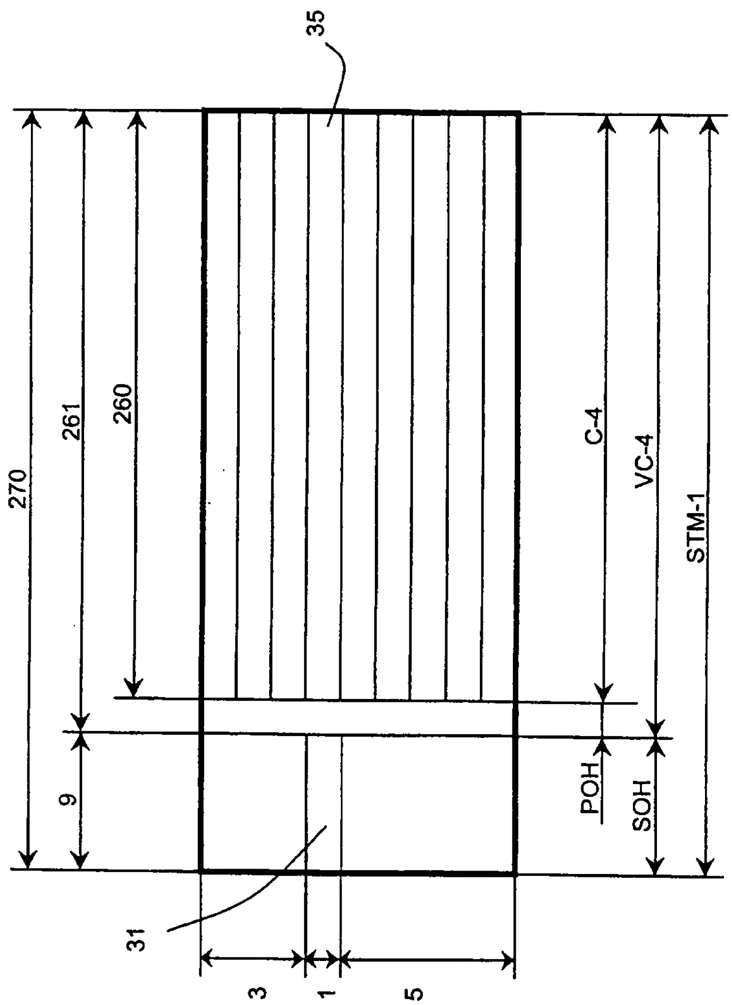

35
270
261
260
9
C-4
VC-4
STM-1
POH
SOH
31
3
1
5

FIG. 2a

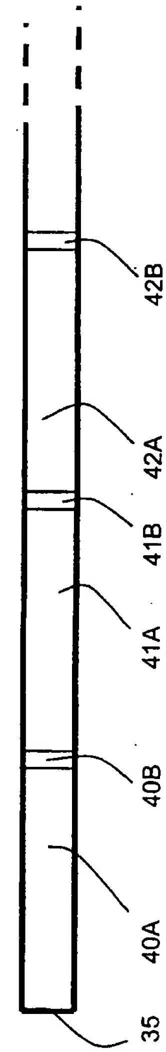

42B
42A
41B
41A
40B
40A
35

FIG. 2b